

WHAT IS CLAIMED IS:

1. An apparatus comprising a circuit which includes:

5 a first portion having a resonant tunneling device arranged so that, in response to an input signal, said resonant tunneling device causes an electrical signal characteristic to undergo a quantum jump in magnitude from a first value to a second value, said second value  
10 being substantially different from said first value, and said quantum jump in magnitude from said first value to said second value taking an interval of time; and

a second portion having a differentiator which responds to said quantum jump of said electrical signal  
15 characteristic from said first value to said second value by producing a narrow pulse having a duration which is approximately equal to said interval of time.

2. An apparatus according to Claim 1, wherein said  
20 resonant tunneling device is a resonant tunneling diode, and said electrical signal characteristic is a voltage across said resonant tunneling diode.

3. An apparatus according to Claim 2, wherein said  
25 differentiator includes first and second capacitors which each have first and second ends, said first end of each said capacitor being coupled to a respective end of said resonant tunneling diode.

4. An apparatus according to Claim 2, wherein said first portion includes:

5 first and second resistors which each have a first end coupled to a respective end of said resonant tunneling diode, and a second end coupled to ground; and

first and second capacitors which each have a first end coupled to a respective end of said resonant tunneling diode, and a second end coupled to ground.

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5. An apparatus according to Claim 2, wherein said first portion includes a transformer having an input coil responsive to said input signal, and having an output coil with first and second ends which are each coupled to  
15 a respective end of said resonant tunneling diode.

6. An apparatus according to Claim 2,

wherein said resonant tunneling diode has first and second ends, said first end of said resonant tunneling  
20 diode being coupled to a first bias voltage; and

wherein said first portion includes:

a resistor having first and second ends, said second end of said resistor being coupled to a second bias voltage less than said first bias voltage; and

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a transistor having two terminals respectively coupled to said second end of said resonant tunneling diode and said first end of said resistor, and having a control terminal coupled to said input signal.

7. An apparatus according to Claim 2,  
wherein said resonant tunneling diode has first and  
second ends, said second end of said resonant tunneling  
5 diode being coupled to ground; and

wherein said first portion includes:

a resistor having first and second ends, said second  
end of said resistor being coupled to said first end of  
said resonant tunneling diode;

10 a transistor having a first terminal coupled to a  
first bias voltage, a second terminal coupled to said  
first end of said resistor, and a control terminal  
coupled to said input signal; and

a constant current source having a first end coupled  
15 to said second terminal of said transistor, and a second  
end coupled to a second bias voltage which is less than  
said first bias voltage.

8. An apparatus according to Claim 7, wherein said  
20 constant current source includes a field effect  
transistor having one of the source and drain thereof  
coupled to said first end of said resistor and the other  
of the source and drain thereof coupled to said second  
bias voltage, and having the gate thereof coupled to said  
25 other of said source and drain thereof.

9. An apparatus according to Claim 2,  
wherein said resonant tunneling diode is a first  
resonant tunneling diode and has first and second ends;  
and

5        wherein said first portion includes:

      a second resonant tunneling diode having first and  
second ends, said first end of said first resonant  
tunneling diode being coupled to said second end of said  
second resonant tunneling diode;

10       a reference current source coupled to said first end  
of said first resonant tunneling diode;

      a first resistor having a first end coupled to said  
first end of said second resonant tunneling diode, and a  
second end coupled to said input signal; and

15       a second resistor having a first end coupled to said  
second end of said first resonant tunneling diode and a  
second end coupled to an inverse of said input signal.

10. An apparatus comprising a circuit which includes:

5 a first portion having a resonant tunneling device arranged so that, in response to an input signal, said resonant tunneling device causes an electrical characteristic to undergo a quantum jump in magnitude from a first value to a second value, said second value being substantially different from said first value, and  
10 said quantum jump in magnitude from said first value to said second value taking an interval of time; and

a second portion having a sampling portion with a sampling input for receiving a signal to be sampled, said sampling portion responding to said quantum jump in  
15 magnitude of said electrical signal characteristic from said first value to said second value by causing said sampling portion to sample a signal at said sampling input during a time period which is approximately equal in duration to said interval of time.

20 11. An apparatus according to Claim 10, wherein said second portion includes a differentiator which responds to said quantum jump of said electrical signal characteristic from said first value to said second value  
25 by producing a narrow pulse having a duration which is approximately equal to said interval of time, said sampling portion effecting said sampling in response to and during said narrow pulse from said differentiator.

12. An apparatus according to Claim 10, wherein  
said resonant tunneling device is a resonant tunneling  
diode, and said electrical signal characteristic is a  
5 voltage across said resonant tunneling diode.

13. An apparatus according to Claim 12, wherein  
said first portion includes:

10 first and second resistors which each have a first  
end coupled to a respective end of said resonant  
tunneling diode, and a second end coupled to ground; and

first and second capacitors which each have a first  
end coupled to a respective end of said resonant  
tunneling diode, and a second end coupled to ground.

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14. An apparatus according to Claim 12, wherein  
said first portion includes a transformer having an input  
coil responsive to said input signal, and having an  
output coil with first and second ends which are each  
20 coupled to a respective end of said resonant tunneling  
diode.

15. An apparatus according to Claim 12,  
wherein said resonant tunneling diode has first and  
second ends, said first end of said resonant tunneling  
diode being coupled to a first bias voltage; and

5 wherein said first portion includes:

a resistor having first and second ends, said second  
end of said resistor being coupled to a second bias  
voltage less than said first bias voltage; and

10 a transistor having two terminals respectively  
coupled to said second end of said resonant tunneling  
diode and said first end of said resistor, and having a  
control terminal coupled to said input signal.

16. An apparatus according to Claim 12,

15 wherein said resonant tunneling diode has first and  
second ends, said second end of said resonant tunneling  
diode being coupled to ground; and

wherein said first portion includes:

20 a resistor having first and second ends, said second  
end of said resistor being coupled to said first end of  
said resonant tunneling diode;

25 a transistor having a first terminal coupled to a  
first bias voltage, a second terminal coupled to said  
first end of said resistor, and a control terminal  
coupled to said input signal; and

a constant current source having a first end coupled  
to said second terminal of said transistor, and a second  
end coupled to a second bias voltage which is less than  
said first bias voltage.

17. An apparatus according to Claim 16, wherein  
said constant current source includes a field effect  
transistor having one of the source and drain thereof  
coupled to said first end of said resistor and the other  
of the source and drain thereof coupled to said second  
bias voltage, and having the gate thereof coupled to said  
other of said source and drain thereof.

18. An apparatus according to Claim 12,  
wherein said resonant tunneling diode is a first  
resonant tunneling diode and has first and second ends;  
and

wherein said first portion includes:

a second resonant tunneling diode having first and  
second ends, said first end of said first resonant  
tunneling diode being coupled to said second end of said  
second resonant tunneling diode;

a reference current source coupled to said first end  
of said first resonant tunneling diode;

a first resistor having a first end coupled to said  
first end of said second resonant tunneling diode, and a  
second end coupled to said input signal; and

a second resistor having a first end coupled to said  
second end of said first resonant tunneling diode and a  
second end coupled to an inverse of said input signal.



19. A method comprising:

providing a circuit having a first portion which includes a resonant tunneling device, and a second  
5 portion which includes a differentiator;

applying to said first portion an input signal;

causing said resonant tunneling device to respond to said input signal by effecting a quantum jump in magnitude of an electrical signal characteristic from a  
10 first value to a second value, said second value being substantially different from said first value, and said quantum jump in magnitude from said first value to said second value taking an interval of time; and

causing said differentiator to respond to said  
15 quantum jump of said electrical signal characteristic from said first value to said second value by producing a narrow pulse having a duration which is approximately equal to said interval of time.

20 20. A method according to Claim 19, including selecting as said resonant tunneling device a resonant tunneling diode, said electrical signal characteristic being a voltage across said resonant tunneling diode.

25 21. A method according to Claim 20, including configuring said differentiator to have first and second capacitors which each have first and second ends, said first end of each said capacitor being coupled to a respective end of said resonant tunneling diode.

22. A method comprising:

providing a circuit having a first portion which includes a resonant tunneling device, and a second  
5 portion which includes a sampling portion with a sampling input;

applying to said first portion an input signal;

applying to said sampling input a signal to be  
sampled;

10 causing said resonant tunneling device to respond to said input signal by effecting a quantum jump in magnitude of an electrical signal characteristic from a first value to a second value, said second value being substantially different from said first value, and said  
15 quantum jump in magnitude from said first value to said second value taking an interval of time; and

causing said sampling portion to respond to said quantum jump in magnitude of said electrical signal characteristic from said first value to said second value  
20 by sampling the signal at said sampling input during a time period which is approximately equal in duration to said interval of time.

23. A method according to Claim 22, including:  
configuring said second portion to include a  
differentiator;

5 causing said differentiator to respond to said  
quantum jump of said electrical signal characteristic  
from said first value to said second value by producing a  
narrow pulse having a duration which is approximately  
equal to said interval of time; and

10 causing said sampling portion to effect said  
sampling in response to and during said narrow pulse from  
said differentiator.

24. A method according to Claim 22, including  
15 selecting as said resonant tunneling device a resonant  
tunneling diode, said electrical signal characteristic  
being a voltage across said resonant tunneling diode.